



# STP5NB100 STP5NB100FP

N-CHANNEL 1000V - 2.4Ω - 5A TO-220/TO-220FP

PowerMesh™ MOSFET

| TYPE        | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-------------|------------------|---------------------|----------------|
| STP5NB100   | 1000 V           | < 2.7 Ω             | 5 A            |
| STP5NB100FP | 1000 V           | < 2.7 Ω             | 5 A            |

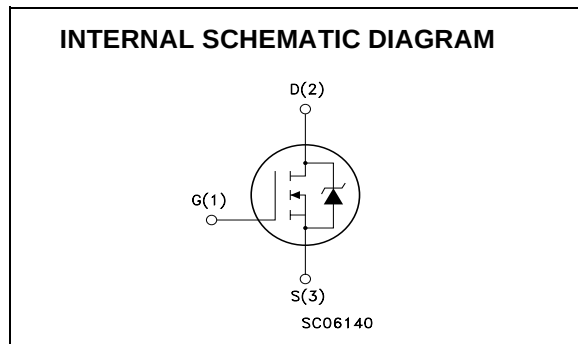
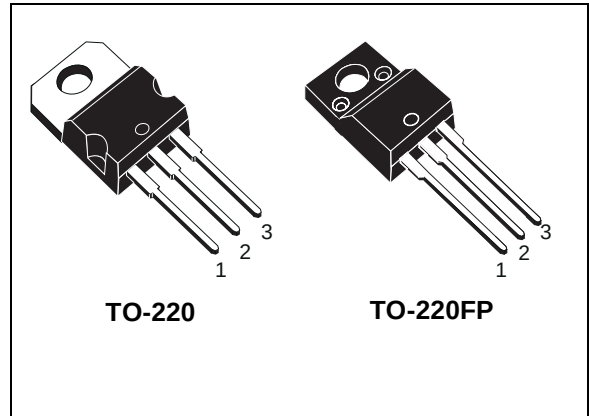
- TYPICAL R<sub>DS(on)</sub> = 2.4 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

## DESCRIPTION

Using the latest high voltage MESH OVERLAY™ process, STMicroelectronics has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest R<sub>DS(on)</sub> per area, exceptional avalanche and dv/dt capabilities and unrivalled gate charge and switching characteristics.

## APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVE



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                            | Value      |             | Unit |
|---------------------|------------------------------------------------------|------------|-------------|------|
|                     |                                                      | STP5NB100  | STP5NB100FP |      |
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)           | 1000       |             | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 1000       |             | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                 | ±30        |             | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C  | 5          | 5 (*)       | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 3.1        | 3.1 (*)     | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                               | 15.2       | 15.2 (*)    | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 135        | 40          | W    |
|                     | Derating Factor                                      | 1.08       | 0.32        | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                    | 4.5        | 4.5         | V/ns |
| V <sub>ISO</sub>    | Insulation Withstand Voltage (DC)                    | -          | 2500        | V    |
| T <sub>stg</sub>    | Storage Temperature                                  | -65 to 150 |             | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                  | 150        |             | °C   |

(•) Pulse width limited by safe operating area

(\*) Limited only by maximum temperature allowed

(1) I<sub>SD</sub> ≤ 4.7A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

## STP5NB100 - STP5NB100FP

### THERMAL DATA

|                |                                                | TO-220 | TO-220FP |      |
|----------------|------------------------------------------------|--------|----------|------|
| Rthj-case      | Thermal Resistance Junction-case Max           | 0.93   | 3.12     | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient Max        | 62.5   |          | °C/W |
| T <sub>I</sub> | Maximum Lead Temperature For Soldering Purpose | 300    |          | °C   |

### AVALANCHE CHARACTERISTICS

| Symbol          | Parameter                                                                                                                  | Max Value | Unit |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|-----------|------|
| I <sub>AR</sub> | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)                                | 5         | A    |
| E <sub>AS</sub> | Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V) | 220       | mJ   |

### ELECTRICAL CHARACTERISTICS (TCASE = 25 °C UNLESS OTHERWISE SPECIFIED)

#### OFF

| Symbol               | Parameter                                             | Test Conditions                                                                       | Min. | Typ. | Max.    | Unit     |
|----------------------|-------------------------------------------------------|---------------------------------------------------------------------------------------|------|------|---------|----------|
| V <sub>(BR)DSS</sub> | Drain-source Breakdown Voltage                        | I <sub>D</sub> = 250 µA, V <sub>GS</sub> = 0                                          | 1000 |      |         | V        |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0) | V <sub>DS</sub> = Max Rating<br>V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C |      |      | 1<br>50 | µA<br>µA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ±30V                                                                |      |      | ±100    | nA       |

#### ON <sup>(1)</sup>

| Symbol              | Parameter                         | Test Conditions                                             | Min. | Typ. | Max. | Unit |
|---------------------|-----------------------------------|-------------------------------------------------------------|------|------|------|------|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 µA | 3    | 4    | 5    | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.5 A               |      | 2.4  | 2.7  | Ω    |

### DYNAMIC

| Symbol              | Parameter                    | Test Conditions                                                                           | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|-------------------------------------------------------------------------------------------|------|------|------|------|
| g <sub>fs</sub> (1) | Forward Transconductance     | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DS(on)</sub> max,<br>I <sub>D</sub> = 2.5 A | 1.5  |      |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0                                     |      | 1500 |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |                                                                                           |      | 150  |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |                                                                                           |      | 17   |      | pF   |

## ELECTRICAL CHARACTERISTICS (CONTINUED)

### SWITCHING ON

| Symbol                        | Parameter                                                    | Test Conditions                                                                                                              | Min. | Typ.              | Max. | Unit           |
|-------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------|-------------------|------|----------------|
| $t_{d(on)}$<br>$t_r$          | Turn-on Delay Time<br>Rise Time                              | $V_{DD} = 500\text{ V}$ , $I_D = 2.5\text{ A}$<br>$R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |      | 24<br>11          |      | ns<br>ns       |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD} = 800\text{ V}$ , $I_D = 5\text{ A}$ ,<br>$V_{GS} = 10\text{ V}$                                                     |      | 39<br>9.6<br>19.2 | 51   | nC<br>nC<br>nC |

### SWITCHING OFF

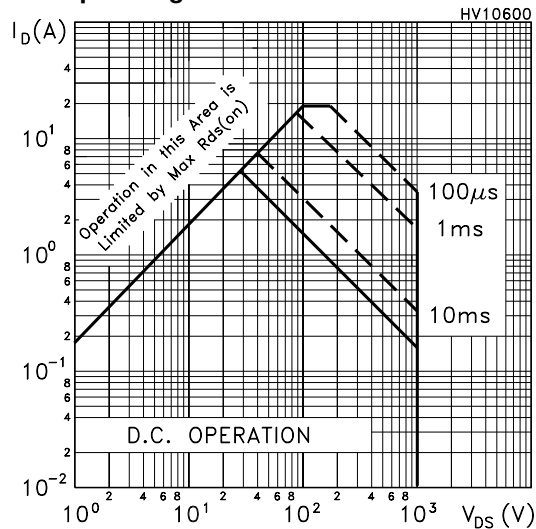
| Symbol                          | Parameter                                             | Test Conditions                                                                                                              | Min. | Typ.           | Max. | Unit           |
|---------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------|----------------|------|----------------|
| $t_{r(Voff)}$<br>$t_f$<br>$t_c$ | Off-voltage Rise Time<br>Fall Time<br>Cross-over Time | $V_{DD} = 800\text{ V}$ , $I_D = 5\text{ A}$ ,<br>$R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 5) |      | 20<br>22<br>26 |      | ns<br>ns<br>ns |

### SOURCE DRAIN DIODE

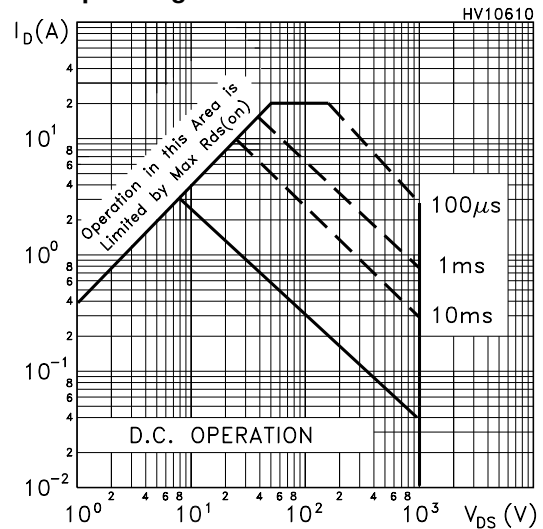
| Symbol                            | Parameter                                                                    | Test Conditions                                                                                                                                     | Min. | Typ.             | Max.    | Unit                     |
|-----------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------|---------|--------------------------|
| $I_{SD}$<br>$I_{SDM(1)}$          | Source-drain Current<br>Source-drain Current (pulsed)                        |                                                                                                                                                     |      |                  | 5<br>20 | A<br>A                   |
| $V_{SD(2)}$                       | Forward On Voltage                                                           | $I_{SD} = 5\text{ A}$ , $V_{GS} = 0$                                                                                                                |      |                  | 1.6     | V                        |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 100\text{ V}$ , $T_j = 150^\circ\text{C}$<br>(see test circuit, Figure 5) |      | 780<br>5.5<br>14 |         | ns<br>$\mu\text{C}$<br>A |

Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.  
2. Pulse width limited by safe operating area.

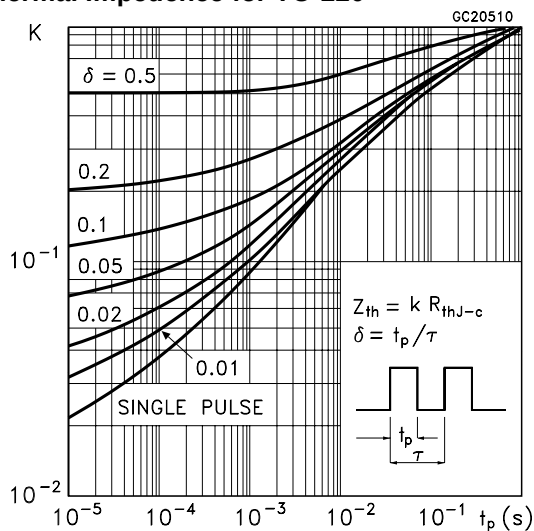
Safe Operating Area for TO-220



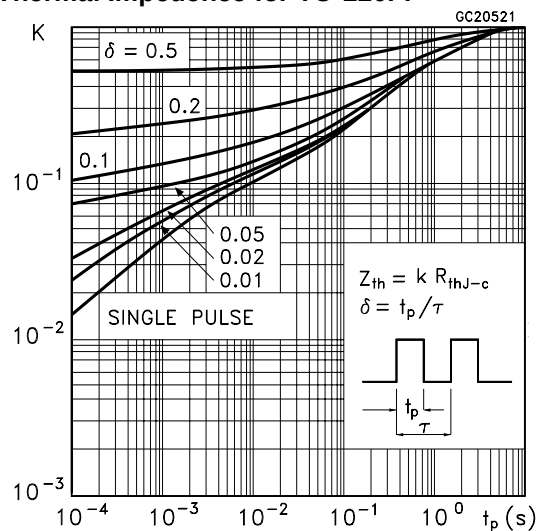
Safe Operating Area for TO-220FP



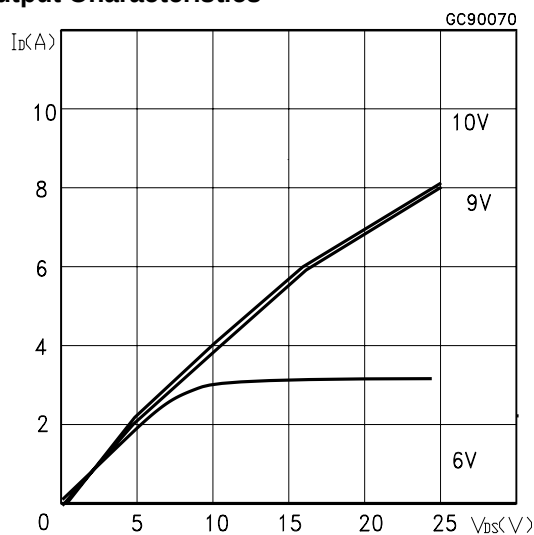
Thermal Impedance for TO-220



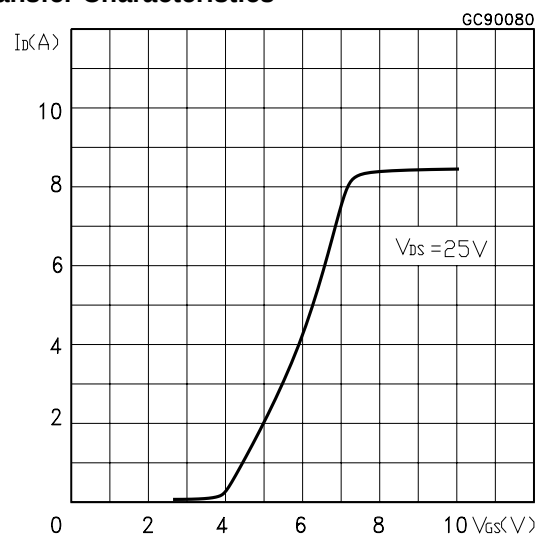
Thermal Impedance for TO-220FP



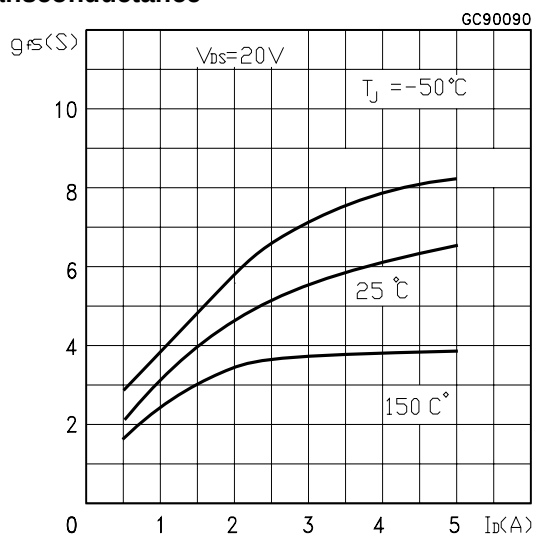
Output Characteristics



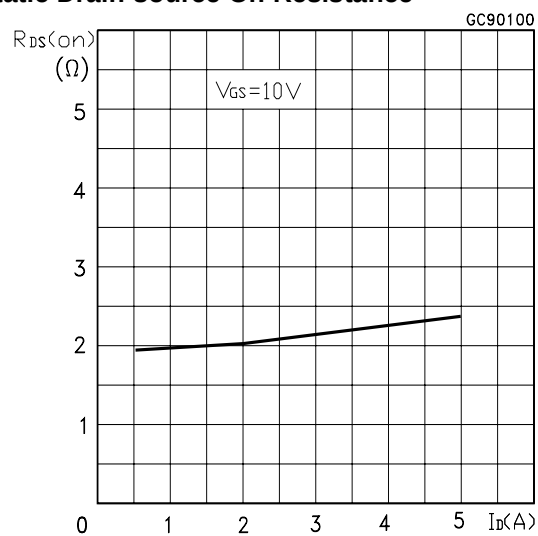
Transfer Characteristics



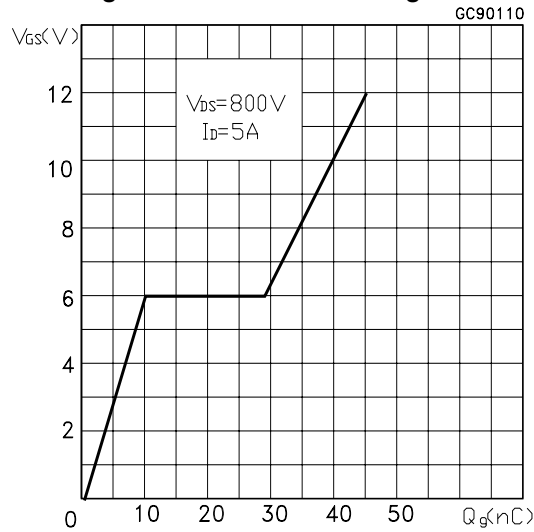
Transconductance



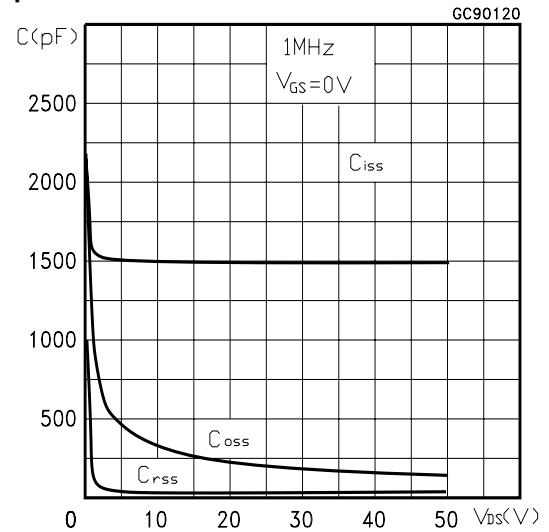
Static Drain-source On Resistance



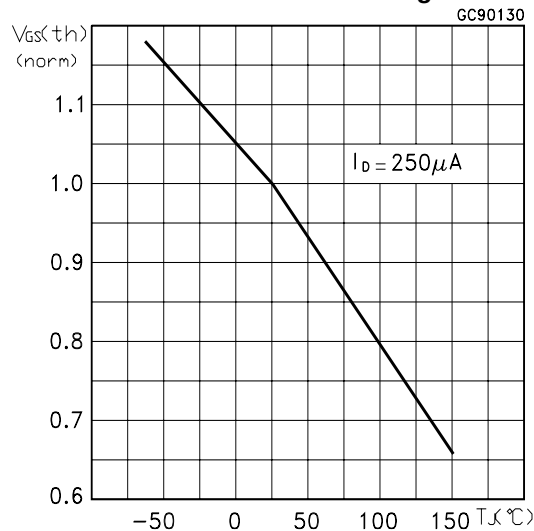
Gate Charge vs Gate-source Voltage



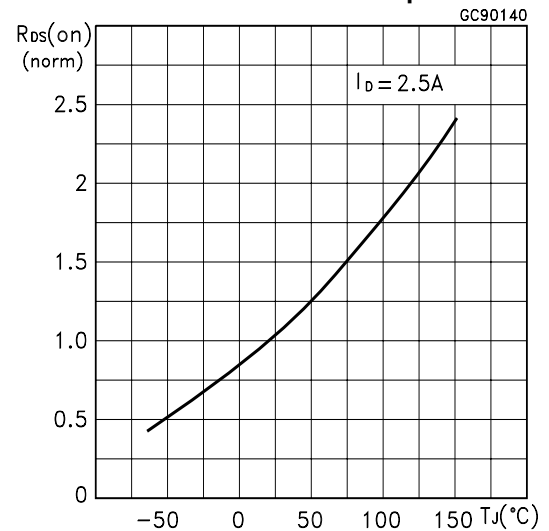
Capacitance Variations



Normalized Gate Threshold Voltage vs Temp.



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

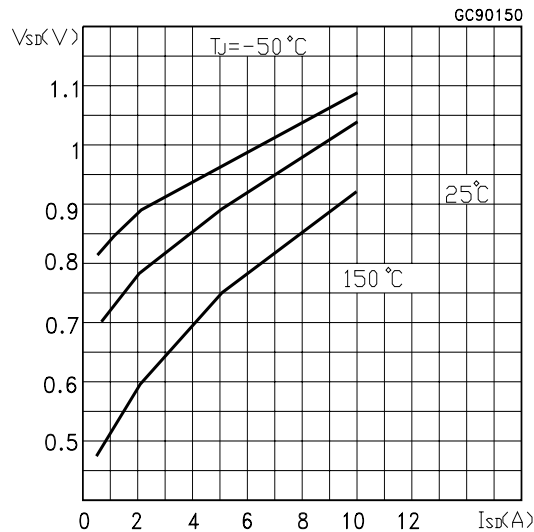


Fig. 1: Unclamped Inductive Load Test Circuit

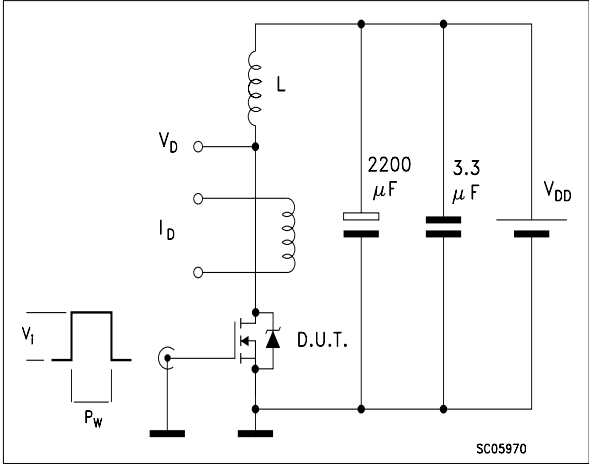


Fig. 2: Unclamped Inductive Waveform

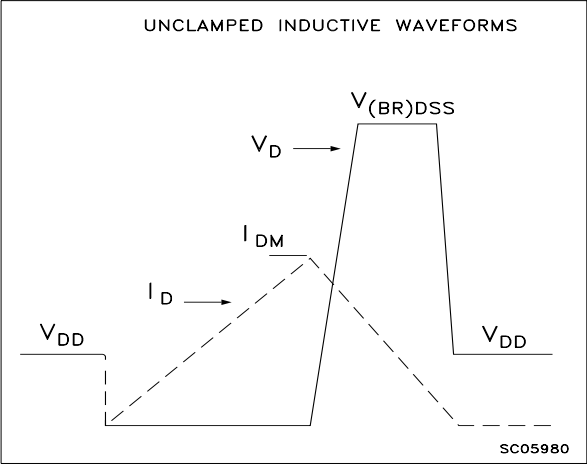


Fig. 3: Switching Times Test Circuit For Resistive Load

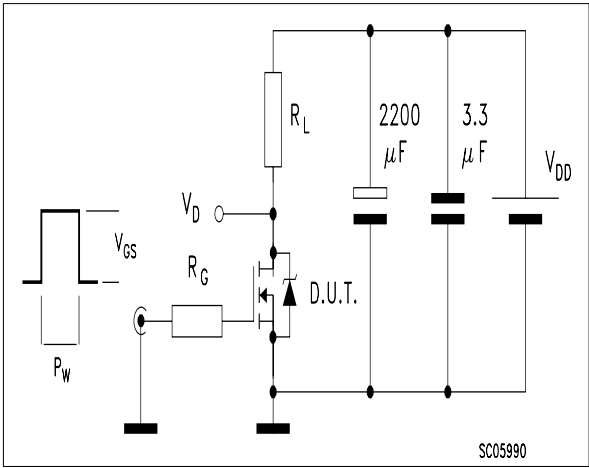


Fig. 4: Gate Charge test Circuit

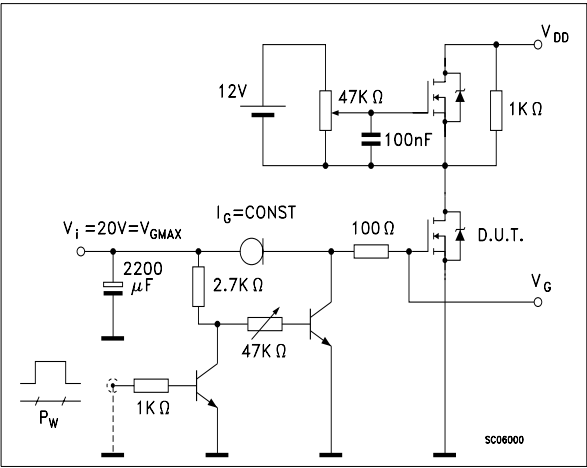
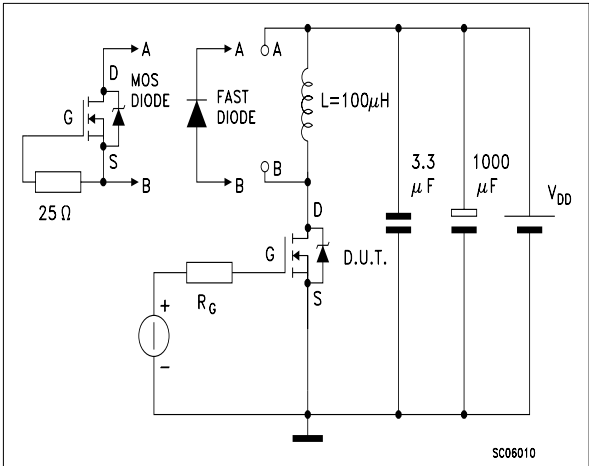
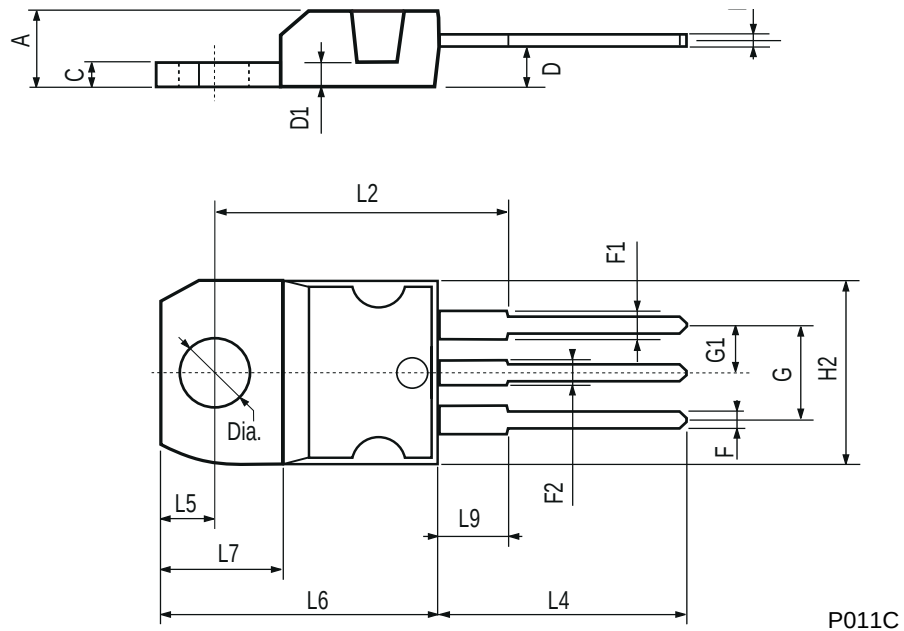


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



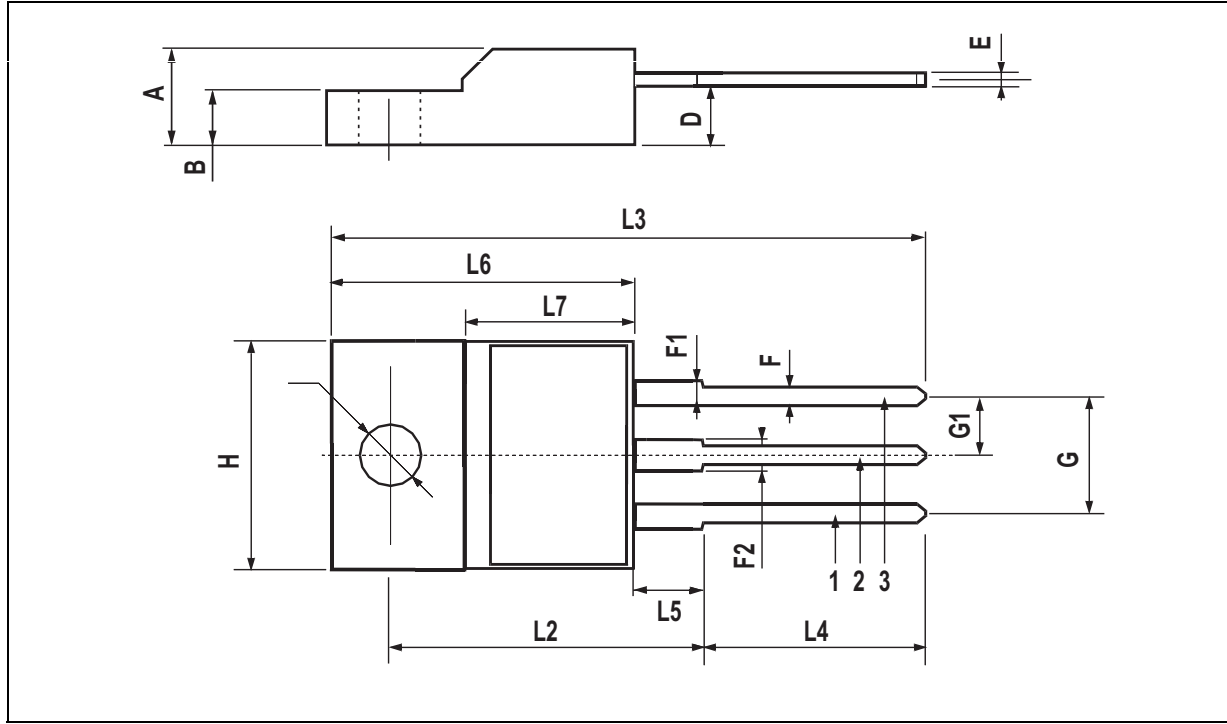
TO-220 MECHANICAL DATA

| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.40  |      | 4.60  | 0.173 |       | 0.181 |
| C    | 1.23  |      | 1.32  | 0.048 |       | 0.051 |
| D    | 2.40  |      | 2.72  | 0.094 |       | 0.107 |
| D1   |       | 1.27 |       |       | 0.050 |       |
| E    | 0.49  |      | 0.70  | 0.019 |       | 0.027 |
| F    | 0.61  |      | 0.88  | 0.024 |       | 0.034 |
| F1   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| F2   | 1.14  |      | 1.70  | 0.044 |       | 0.067 |
| G    | 4.95  |      | 5.15  | 0.194 |       | 0.203 |
| G1   | 2.4   |      | 2.7   | 0.094 |       | 0.106 |
| H2   | 10.0  |      | 10.40 | 0.393 |       | 0.409 |
| L2   |       | 16.4 |       |       | 0.645 |       |
| L4   | 13.0  |      | 14.0  | 0.511 |       | 0.551 |
| L5   | 2.65  |      | 2.95  | 0.104 |       | 0.116 |
| L6   | 15.25 |      | 15.75 | 0.600 |       | 0.620 |
| L7   | 6.2   |      | 6.6   | 0.244 |       | 0.260 |
| L9   | 3.5   |      | 3.93  | 0.137 |       | 0.154 |
| DIA. | 3.75  |      | 3.85  | 0.147 |       | 0.151 |



TO-220FP MECHANICAL DATA

| DIM. | mm.  |     |      | inch  |       |       |
|------|------|-----|------|-------|-------|-------|
|      | MIN. | TYP | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |     | 4.6  | 0.173 |       | 0.181 |
| B    | 2.5  |     | 2.7  | 0.098 |       | 0.106 |
| D    | 2.5  |     | 2.75 | 0.098 |       | 0.108 |
| E    | 0.45 |     | 0.7  | 0.017 |       | 0.027 |
| F    | 0.75 |     | 1    | 0.030 |       | 0.039 |
| F1   | 1.15 |     | 1.5  | 0.045 |       | 0.067 |
| F2   | 1.15 |     | 1.5  | 0.045 |       | 0.067 |
| G    | 4.95 |     | 5.2  | 0.195 |       | 0.204 |
| G1   | 2.4  |     | 2.7  | 0.094 |       | 0.106 |
| H    | 10   |     | 10.4 | 0.393 |       | 0.409 |
| L2   |      | 16  |      |       | 0.630 |       |
| L3   | 28.6 |     | 30.6 | 1.126 |       | 1.204 |
| L4   | 9.8  |     | 10.6 | .0385 |       | 0.417 |
| L5   | 2.9  |     | 3.6  | 0.114 |       | 0.141 |
| L6   | 15.9 |     | 16.4 | 0.626 |       | 0.645 |
| L7   | 9    |     | 9.3  | 0.354 |       | 0.366 |
| Ø    | 3    |     | 3.2  | 0.118 |       | 0.126 |





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